

SORGET

Social and Organisational Issues in the Adoption of Advanced
Energy Technologies in Manufacturing

Final Report

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1 Introduction

SORGET is a research and development project funded by the European Commission under the Joule III Programme. The aim of the project is to look at social and organisational issues in the adoption of advanced energy technologies in manufacturing and to pinpoint forces that encourage or discourage the effective take-up of advanced energy-efficient technologies within manufacturing processes. To understand the social and economic forces and organisational processes which encourage or discourage decisions within industrial companies the project employs social science perspectives. It examines the organisational processes that affect the course of implementation of advanced energy technologies and investigates the consequences for the effectiveness of these technologies in use.

The project draws out the implications for regional, national and European Union policies intended to encourage rational use of energy within industry. The research aims to contribute to an understanding of non-technological barriers and incentives affecting industrial take-up of energy technologies. Understanding these barriers is a way of bringing to visibility the hidden costs of investment in advanced energy technologies which apparently inhibit their take-up. Once the nature of these hidden organisational costs has been understood, public policies can be devised to help industry overcome them.

As part of the work the research involves an assessment of national contexts affecting company-level decision making in the UK, Netherlands, Denmark and Italy. Case studies of firms in energy intensive sectors, such as iron and steel, paper-making, chemicals, and food are undertaken. These case studies focus on understanding the external influences and internal organisational processes that have facilitated adoption of various kinds of energy efficient process technologies relevant to a particular sector, the issues that have had to be addressed, and the approaches adopted for doing so.

For the case studies undertaken in Germany by the Fraunhofer Institute (ISI) the foundry and paper industry were chosen for the survey. To get comparable results within all case studies undertaken in different countries of the EU, a questionnaire developed by the Tavistock Institute, London and translated into German language was used for the interviews. The questionnaire used is divided in different parts which can be summarised by background company informations, presence of advanced energy technologies, energy market and EU regulations, market and competitive pressures, priority of energy in management and socio-technical characteristics and constraints. Due to the strict time schedule, the target number for the survey was set to ten companies for the foundry industry and the paper industry. All interviews were made by telephone during December 1997.

2 Results of the Survey

2.1 General remarks

Table 1 shows the number of companies that were contacted in the survey and the number of companies which agreed to participate. It includes the reasons why about half of the contacted companies did not take part. The main reason was that the contact persons (mainly engineers) said, they did not have time to go through the survey.

Table 1: Number of companies contacted and reasons for refusing the interview

number of	foundries	paper industry
companies contacted	19	19
contact persons who could not be reached	4	1
companies which answer only written surveys	5	2
contact persons who say that they do not have time		4
companies which are afraid of leakage of confidential information		1
companies which get 4-5 questionnaires per week, which is too much work		1
contact persons who do not have time because of renovation of the production line	1	1
companies which exist only since half a year		
companies which participated in the survey	9	9

During the study we experienced that it was very difficult to reach the contact persons, the best time for talking to them was the afternoon. After having cleared that a company was interested in taking part in the interview, an appointment was arranged (28% of the interviewees wanted to go through the questionnaire immediately). 17% of the interviews could not be held at the appointed time because of technical problems in the company or because the contact person was out or simply would not answer the phone. They took part in the survey at a later time.

Most interviewees would answer the questions eagerly, very detailed, only two (one of the paper industry and one of the foundries) said, that they did not have much time, and thus they hurried through the interview in 15 minutes. Generally the interviewees were very friendly. Some started discussing the sense and meaning of some of the survey's questions, which will be explained in greater detail below.

The average interview time was 43 minutes for the foundries, 35 minutes for the paper industry.

45% of the questioned foundries are SME, 33% are large companies, 22% are part of a multinational corporation.

67% of the questioned paper producers are SMEs, 11% are large companies, 22% belong to a multinational corporation.

Throughout the survey the interviewees mentioned that money is the most important factor, and since the companies are mostly high energy intensive, money is the largest reason to invest into AETs. In the questioning section about the presence of AETs many interviewees stated that they are ALL THE TIME working on projects to save energy, so it was partly difficult to indicate the time when a certain technology had been optimized.

The interviewees mentioned that energy saving in the area of lightning is almost irrelevant. Some stated safety reasons why energy saving in this sector is limited. Still they do apply most energy saving measures in this sector.

A few interviewees (about 15%) pointed out that the list of AETs was incomplete. To their opinion waste incineration plants and bio mass plants should be included.

22% of the foundries said that the own production to electricity does not pay back. Only 11% of the paper producers mentioned that their power plant might be closed in the future, the others, however, value their power plant and keep on enlarging and optimizing it.

Concerning the awareness of EC standards (question 34), the interviewees often mentioned German regulations concerning emissions, etc. The effect of German laws on the firm is that they must strictly fulfill them. Sometimes it was not clear whether the German laws are based on EC regulations or whether they are only national laws.

Question 36 asks, if the companies have access to different power suppliers. In Germany so far it is not possible to choose among several suppliers for electricity, it is not yet available on a free market. Still most of the companies negotiate about the price for electricity with their supplier (89% of the foundries, 67% of the paper producers).

The questions 95 to 106 ask for factors that could be hindering to implement advanced energy technologies. Several interviewees stated that the technical factors are not important at all, the only factor is the return of investment. If the pay back period was short, the new technology would be adopted. Certainly the risk of the new technology would have to be minimized, but the cost of this minimization would be included in the pay back period.

2.2 Additional Information on Foundries

In the survey background information on the company, on awareness of EC-standards (question 43) and on the presence of a formal energy policy (question 71) was gathered. Table 2 shows this extra information on foundries.

It can be summarized that 78% of the interviewed companies produce cast iron products, 22% process aluminium. It should be noted that these aluminium processing companies use liquid aluminium as raw product which means that their energy demand differs from the cast iron foundries. Still they have melting furnaces for scrap metal. 78% of the questioned firms produce for other industrial producers, 22% for the end consumers, 22% for both.

67% of the interviewees are not aware of particular EC-standards.

55% of the foundries do not have a formal energy policy.

2.3 Additional Information on Paper Producers

Table 3 includes the extra information on the company, on known EC-standards and on the presence of a formal energy policy for the paper industry.

67% of the questioned companies of the paper industry are card board producers, 11% are tissue producers and 22% produce high quality paper.

The tissue producers supply the end consumer with their products, 22% of the paper producers sell to the end consumer as well as to other industrial producers, 67% produce only for other industries.

33% of the paper producers are not aware of EC-standards, 55% are certified after ISO 9001.

Only 11% have an explicit energy policy.

Table 2: Additional information on foundries

case	company information / products	Aware of EC-standards?	Do you have an explicit energy policy?
1	- production for the mechanical construction industry - products: cast iron, steel casting - former East German company	no	no
2	- products: cast iron, steel casting	no	no
3	- products: cast iron	certified after ISO 9001	no
5	- production for the mechanical construction industry - products: cast iron - former East German company	no	no
7	- production for the mechanical construction industry (pumps) - products: cast iron (90%) - Also aluminium (Al) or bronze casting (depending on client)	no	energy concept
8	- products: cast iron	no	"environment management system" is applied in 2 sites
9	- products: cast iron	no	
13	- aluminium rolling mill - they receive liquid Al as raw material	- certified after ISO 9001 and ISO 14001 - they hope to improve the contact to the authority, improve the organisation and task management	ISO 14001, however energy is not the main focus of it
16	- aluminium die casting - they receive liquid Al as raw material	- certified after ISO 9001 (but not in energy sector) (ISO 14001 next year)	work groups exist with the goal to find new energy saving methods

Table 3: Additional information on the paper producers

case	company information / products	Aware of EC-standards?	Do you have an explicit energy policy?
4	- products: tissue paper (material consists of 80% waste paper), 220 - 230 t/d, bandage material (100% chemical pulp) - They have 4 paper machines and are about to install the 5th paper machine which should be completed by the end of 1997.	no	no
6	- products: card board - raw mat.: only waste paper (150 000 t/d)	no	no
10	- product: card board - raw mat.: 100% waste paper	no	no
11	- product: high quality papers - 2 paper machines: 240 000 t/d	- The interviewee asked, if the self commitment to lower the CO ₂ -emission was a EC-standard. This does not have a large impact on the company's behaviour (2)	no
12	- product: card board	- The production line is certified after ISO 9001. Its impact on the company's behaviour is "medium" (3). The interviewee stated that it is difficult to obtain/keep the ISO standard.	no
14	- product: card board for food packaging - raw mat.: 90 - 95% waste paper	- they are planning to get the ISO 14001 certificate	no
15	- products: card board, paper	- the production is certified after ISO 9001, the power plant is not included	no
17	- product: card board	- the plan to get the ISO 14001 certificate has been postponed	no
18	- product: LWC-paper	- certified after ISO - EC-safety standards have to be fulfilled.	they have the "green sheet". The interviewee said that this concerns the efficient resource management (water, energy)

To better understand the different behaviour of the companies in the field of rational use of energy and the use of advanced energy technologies the following two tables summarizes the highlights of technical and other measures.

Case	Foundries	
1	Natural process cooling using a small lake since 50 years Utilisation of furnace waste heat for air preheat for plant ventilation Utilisation of compressor waste heat to produce sanitary hot water Recuperative burners at gas furnaces	- consideration of certification after "Ökoaudit-Verordnung" (similar to ISO 14000) - awareness campaigns for switching of lightning and heating
2	- limitation of maximum power consumption at peak hours - recuperator for combustion air preheat - efficient furnace insulation	- use of waste heat for swimming pool considered
3	- heat recovery from air compressor - variable speed drive for large motors	- Oxygen enrichment for cold wind cupola furnace - certified after ISO 9001, "Ökoaudit" considered
5	- new filters - switched from LF- to MF-furnaces	- participation in benchmarking of "Deutscher Gießereiverband" - certified after ISO 9001, "Ökoaudit" considered
7	- 2 of the crucible furnace will be switched from fuel firing to electric heating - waste heat used for sanitary hot water production - block-type thermal power station, additional modules and absorption refrigeration machine planned	- local heat distribution system planned
8	- waste heat recovery for air preheat - limitation of maximum power consumption at peak hours - liquid metal purchase from nearby company	
9	- recuperator for combustion air preheat - catalytic incineration of exhaust air from paint shop - use of emergency power generating unit at peak hours	

13	<ul style="list-style-type: none"> - oxygen control in fuel fired furnaces - frequency controlled pumps in cooling circuits - absorption refrigeration machine - it has been considered to install a natural gas expander, but it was not adopted (large pay back time) 	<ul style="list-style-type: none"> - local heat distribution system planned - certified after ISO 9001 and "Ökoaudit" - research project about regenerative burners instead of using a central recuperator
16	<ul style="list-style-type: none"> - limitation of maximum power consumption at peak hours - furnace flue gas used to preheat scrap metal - automatic barring of compressed air system - liquid aluminium as raw material 	<ul style="list-style-type: none"> - certified after ISO 9001, "Ökoaudit" considered

Case	Paper Manufacturing	
4	<ul style="list-style-type: none"> - frequency controlled pumps - new steam generation unit using lignite and production wastes - electronic control of air compressors planned for 1998 	
6	<ul style="list-style-type: none"> - frequency controlled pumps 	
10	<ul style="list-style-type: none"> - heat recovery from drying section - combined cycle power generation 	
11	<ul style="list-style-type: none"> - heat recovery from drying section - frequency controlled pumps - energetic use of production waste 	<ul style="list-style-type: none"> - use of heat from sewage plant for heating gymnasium - chlorine free bleaching
12	<ul style="list-style-type: none"> - process water preheat via dryer exhaust air - oxygen control in fuel fired boiler - Electronic process and energy management system - frequency controlled pumps 	<ul style="list-style-type: none"> - certified after ISO 9001 - negotiation energy supplier once a year - gas supplier can interrupt gas supply for 40 day (company can switch to fuel oil)
14	<ul style="list-style-type: none"> - space heating by low temperature waste heat from drying section - combined cycle power generation (Cheng Cycle) - 	<ul style="list-style-type: none"> - "Ökoaudit" considered
15	<ul style="list-style-type: none"> - daylight controlled lightning - oxygen control in fuel fired boiler - frequency controlled compressor 	<ul style="list-style-type: none"> - certified after ISO 9001
17	<ul style="list-style-type: none"> - space heating and combustion air preheat by low temperature waste heat from drying section - 25% of pumps are frequency controlled - reduction of net pressure in compressed air system - thermal vapour compression (drying section) 	<ul style="list-style-type: none"> - "Ökoaudit" had been considered, but has been postponed
18	<ul style="list-style-type: none"> - heat recovery for space heating - frequency controlled pumps and ventilators - control of dew point temperature in drying section 	<ul style="list-style-type: none"> - certified after ISO 9001 - local heat distribution system

3 Tabulated Results

Foundries	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Variables ->	paper	foundry	country	size1	size2	size3	sitesing	sitemult	hienera	midener	lowener	indprod	endcon	AFT	houseke
Case 1	0	1	1	1	0	0	1	0	1	0	0	1	0	1	2
Case 2	0	1	1	1	0	0	0	1	1	0	0	1	0	1	0
Case 3	0	1	1	1	0	0	1	0	1	0	0	0	1	1	2
Case 5	0	1	1	0	1	0	1	0	1	0	0	1	0	1	2
Case 7	0	1	1	0	1	0	1	0	1	0	0	1	1	1	2
Case 8	0	1	1	0	0	1	0	1	1	0	0	1	1	1	0
Case 9	0	1	1	1	0	0	0	1	1	0	0	0	1	1	2
Case 13	0	1	1	0	1	0	1	0	1	0	0	1	0	1	2
Case 16	0	1	1	0	0	1	0	1	0	0	1	1	0	1	3
Average	0.00	1.00	1.00	0.44	0.33	0.22	0.56	0.44	0.89	0.00	0.11	0.78	0.44	1.00	1.67
Paper															
Case 4	1	0	1	1	0	0	1	0	1	0	0	0	1	1	1
Case 6	1	0	1	1	0	0	1	0	1	0	0	1	0	1	3
Case 10	1	0	1	0	0	1	0	1	1	0	0	1	0	1	2
Case 11	1	0	1	0	1	0	1	0	1	0	0	1	0	1	1
Case 12	1	0	1	1	0	0	1	0	1	0	0	1	0	1	2
Case 14	1	0	1	1	0	0	0	1	1	0	0	1	0	1	3
Case 15	1	0	1	1	0	0	0	1	0	1	0	1	1	1	1
Case 17	1	0	1	1	0	0	1	0	0	1	0	1	0	1	1
Case 18	1	0	1	0	0	1	0	1	1	0	0	1	1	1	2
Average	1.00	0.00	1.00	0.67	0.11	0.22	0.56	0.44	0.78	0.22	0.00	0.89	0.33	1.00	1.78

Foundries	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Variables ->	houseke	houseke	houseke	houseke	addson	addson	addson	addson	addson	install1	install2	install3	Core1	Core2	Core3
Case 1	2	0	2	0	0	0	0	2	0	2	0	0	2	0	0
Case 2	1	0	0	0	0	0	2	0	0	0	0	0	2	1	0
Case 3	0	0	3	2	1	0	0	2	0	2	0	0	0	0	0
Case 5	0	0	0	2	0	0	2	0	0	2	0	0	2	2	0
Case 7	2	0	2	2	2	2	0	0	0	1	0	2	2	0	0
Case 8	3	0	0	0	0	0	2	0	0	0	0	0	2	2	0
Case 9	2	0	2	0	0	0	0	0	0	0	0	0	0	0	0
Case 13	1	1	3	0	1	1	1	0	0	1	0	0	0	0	0
Case 16	1	0	2	2	0	0	2	0	0	2	0	0	2	2	0
Average	1.33	0.11	1.56	0.89	0.44	0.33	1.00	0.44	0.00	1.11	0.00	0.22	1.33	0.78	0.00
Paper producers															
Case 4	0	0	3	0	1	0	0	0	0	1	1	0	0	0	0
Case 6	3	3	3	2	3	0	0	0	0	3	2	0	0	0	0
Case 10	3	0	0	0	3	1	0	0	0	0	3	0	0	0	0
Case 11	2	0	0	0	1	2	0	2	0	1	0	0	0	0	0
Case 12	2	2	0	0	2	2	0	2	0	3	0	0	0	0	0
Case 14	3	3	3	3	0	2	0	3	0	0	0	0	0	0	0
Case 15	1	0	2	2	2	1	0	0	0	1	2	0	0	0	0
Case 17	2	0	0	0	2	2	0	3	0	1	0	2	0	0	0
Case 18	1	0	1	1	1	2	0	2	0	2	0	0	0	0	0
Average	1.89	0.89	1.33	0.89	1.67	1.33	0.00	1.33	0.00	1.33	0.89	0.22	0.00	0.00	0.00

Foundries	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45
Variables ->	Core4	Core5	Core6	ecreaul	lmpecre	freemkt	pricene	Opport	priceris	pricetal	enerbuy	enersell	lmprsubi	lmprawa	lmprCst
Case 1	0	0	2	0	0	0	1	1	0	1	0	0	1	2	2
Case 2	0	0	0	0	0	0	0	0	0	1	1	1	3	2	2
Case 3	0	0	0	0	0	0	1	1	0	1	0	1	1	1	1
Case 5	0	0	0	0	0	0	1	1	1	1	1	0	1	3	3
Case 7	0	0	0	0	0	0	1	1	1	0	1	1	2	2	2
Case 8	0	0	0	0	0	0	1	1	1	0	0	1	1	3	3
Case 9	0	0	0	0	0	0	1	1	0	1	0	1	1	1	3
Case 13	0	0	0	1	5	0	1	1	0	0	1	1	4	3	3
Case 16	0	0	0	1	5	0	1	1	0	1	0	0	2	1	1
Average	0.00	0.00	0.22	0.22	1.11	0.00	0.89	0.89	0.33	0.67	0.44	0.67	1.78	2.00	2.22
Paper producers															
Case 4	0	0	0	0	0	0	1	1	0	1	1	0	1	1	1
Case 6	3	0	0	0	0	0	0	0	0	1	0	0	3	3	1
Case 10	0	0	0	0	5	0	1	1	1	0	0	0	1	1	1
Case 11	0	0	1	0	2	0	1	1	0	0	1	1	3	2	2
Case 12	0	0	0	0	3	0	1	1	0	1	1	1	2	2	3
Case 14	0	0	0	0	0	0	0	0	0	0	1	0	4	4	1
Case 15	0	0	0	0	0	0	1	1	0	1	0	1	1	2	1
Case 17	0	0	0	0	0	0	1	0	0	1	0	1	4	1	1
Case 18	2	0	0	1	5	0	0	0	0	1	1	1	2	1	1
Average	0.56	0.00	0.11	0.11	1.67	0.00	0.67	0.56	0.11	0.67	0.56	0.56	2.33	1.89	1.33

Foundries	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
Variables ->	impccota	implevy	imp-fina	imp-eco	comp-	impgov	impresed	impprof	int&d	inconsul	inportn	insupca	insupgo	insupma	inothet
Case 1	1	3	1	3	1	2	1	4	1	4	1	1	1	1	4
Case 2	2	2	2	4	2	2	2	2	4	2	2	4	4	1	1
Case 3	1	1	1	3	3	2	3	3	1	3	4	4	1	1	2
Case 5	1	1	1	5	4	1	3	5	1	5	3	4	5	3	1
Case 7	3	4	4	4	2	1	2	4	1	2	1	2	2	2	3
Case 8	2	2	2	3	1	1	3	3	2	2	2	3	3	3	3
Case 9	1	1	1	3	2	2	4	4	1	1	1	3	4	1	1
Case 13	2	3	4	3	1	1	4	2	1	4	1	1	2	1	1
Case 16	3	1	2	5	5	2	3	4	1	5	3	5	4	4	3
Average	1.78	2.00	2.00	3.67	2.33	1.56	2.78	3.44	1.44	3.11	2.00	3.00	2.89	1.89	2.11
Paper producers															
Case 4	2	1	1	4	2	1	1	3	1	1	2	2	3	1	1
Case 6	5	5	3	3	5	1	3	5	1	5	1	4	2	1	4
Case 10	1	1	1	5	3	3	1	3	1	3	2	4	1	3	1
Case 11	2	2	4	4	1	2	2	3	1	2	1	5	1	1	4
Case 12	2	2		4	4	3	2	1	4	2	2	3	4	1	4
Case 14	3	3	1	4	3	2	3	4	1	4	4	2	3	1	1
Case 15	1	1	1	3	3	1	2	2	1	1	3	3	2	1	2
Case 17	4	1	1	3	5	4	2	2	4	4	1	4	1	1	4
Case 18	5	2	1	5	1	1	1	1	2	1	5	5	1	1	5
Average	2.78	2.00	1.63	3.89	3.00	2.00	1.89	2.67	1.78	2.56	2.33	3.56	2.00	1.22	2.89

Foundries	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
Variables ->	infogov	infores	infopro	infor&d	infocon	inforpor	infosu1	infosu2	infosu3	infooth	policy	deftop	defsenio	defmidl	defjunio
Case 1			a				a			b	0				
Case 2											0				
Case 3	a	a	d	e		a					0				
Case 5		a, b	d		d			b, c,			0				
Case 7			a, b, c							d, e	1	1	1	1	1
Case 8		a	a, b, c		a			d, e			1	1	1	1	1
Case 9		a, b, c	a, b, c				b	b			0				
Case 13		b			b			e			1	1	1	1	1
Case 16		a	a, c		a, c, e	d	a				1	1	1	1	1
Average											0,44				
Paper producers															
Case 4			a			a, b					0				
Case 6		a	a, b, c		e					e	0				
Case 10	a, e		a, b, c				a, b, c		a, b		0				
Case 11			a				a, b, c			b	0				
Case 12				Opt. of				b		a, b	0				
Case 14			a, b, c		a, b, c	a		b			0				
Case 15											0				
Case 17	laws			Opt. of	e		e			a, b, c	0				
Case 18						a, e	a, b				1	0	1	0	0
Average											0,11				

Foundries	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90
Variables ->	defother	def-fin	def-	defema	polman-	polman-	polman-	monit-fin	monit-	monit-	pricost	pricusto	prilma	pristrat	Hlimp
Case 1											5	1	3	3	1
Case 2											5	3	4	2	1
Case 3											5	1	2	4	0
Case 5											5	3	3	3	1
Case 7	1	0	1	0	0	1	0	0	1	0	5	2	4	4	0
Case 8	1	1	1	0	0	1	0	1	0	0	5	1	3	3	0
Case 9											5	3	2	5	0
Case 13	1	1	1	1	0	1	1	0	0	1	5	4	1	3	0
Case 16	1	1	1	1	0	1	0	1	0	0	5	3	3	3	0
Average											5.00	2.33	2.78	3.33	0.33
Paper producers															
Case 4											5	2	4	3	1
Case 6											5	3	3	5	1
Case 10											5	5	3	3	1
Case 11											4	1	1	1	0
Case 12											5	3	4	5	0
Case 14											5	3	4	4	1
Case 15											5	3	4	3	0
Case 17											5	3	2	4	1
Case 18	0	0	1	1	0	0	1	1	0	0	5	5	5	5	0
Average											4.89	3.11	3.33	3.67	0.56

Foundries	91	92	93	94	95	96	97	98	99	100	101	102	103	104	105	106
Variables ->	secimo	medim	minimo	lanored	socitec	socitec	socitec	socitec	socitec	socitec	socitec	socitec	socitec9	socitec10	socitec11	socitec12
Case 1	0	0	0	0	1	1	3	2	3	1	3	3	3	2	1	3
Case 2	0	0	0	0	3	3	3	3	1	1	3	1	1	1	2	3
Case 3	1	0	0	0	3	3	3	2	2	1	2	3	1	1	2	2
Case 5	0	0	0	0	3	2	3	1	2	3	3	3	3	1	1	3
Case 7	1	1	0	0	2	2	1	1	1	1	2	3	1	3	3	3
Case 8	0	1	0	0	3	3	2	1	2	3	3	2	1	3		3
Case 9	0	1	0	0	3	3	3	2	2	1	1	1	1	3	1	1
Case 13	0	1	0	0	3	2	2	1	1	1	3	3	2	3	1	3
Case 16	1	0	0	0	3	3	2	2	3	3	3	2	1	3	1	3
Average	0.33	0.44	0.00	0.00	2.67	2.44	2.44	1.67	1.89	1.67	2.56	2.33	1.56	2.22	1.50	2.67
Paper																
Case 4	0	0	0	0	1	2	2	1	1	3	3	3	1	2	3	3
Case 6	0	0	0	0	1	1	2	1	1	3	3	1	1	2	1	3
Case 10	0	0	0	0	2	1	3	1	3	3	1	1	1	3	2	3
Case 11	1	1	0	0	3	2	2	1	1	3	3	3	1	1	1	1
Case 12	1	0	0	0	1	2	2	1	3	2	3	2	1	2	1	1
Case 14	0	0	0	0	1	2	2	2	2	2	3	1	1	3	1	3
Case 15	1	0	0	0	3	3	2	2	2	3	2	2	2	3	1	3
Case 17	0	0	0	0	3	3	2	3	2	3	3	3	3	1	1	1
Case 18	1	0	0	0	1	1	2	1	3	3	3	2	1	3	1	3
Average	0.44	0.11	0.00	0.00	1.78	1.89	2.11	1.44	2.00	2.78	2.67	2.00	1.33	2.22	1.33	2.33

4 Appendix

4.1 Questionnaire for the survey

The questionnaire used for the telephone interviews were not send to the companies. It was used only for the interviewee to ask the questions and to mark the answers and additional information gathered during the interviews.

SORGET SURVEY (revised version)

BACKGROUND: COMPANY INFORMATION

Please could you give us some information about your company: describe the company in terms of core business, type of market:

Sector:

- | | | | | | | | | |
|---------------------|-----|----|---------|---|----|---|----|---------|
| 1. Paper industry | YES | NO | paper | | | | | |
| 2. Foundry industry | YES | NO | foundry | | | | | |
| 3. Country: | D | DK | E | I | NL | S | UK | country |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | |

What would you classify the size of the company in terms of the number of employees, turnover, and profitability?

- | | | | |
|--|-----|----|-------|
| 4. SME (< 500 employers) | YES | NO | size1 |
| 5. Large company | YES | NO | size2 |
| 6. Part of a multinational corporation | YES | NO | size3 |

How would you describe the firm:

- | | | | |
|-----------------|-----|----|----------|
| 7. Single site? | YES | NO | sitesing |
| 8. Multi-site? | YES | NO | sitemult |

What proportion of product costs are energy costs (how energy intensive is it)?

- | | | | |
|---|-----|----|----------|
| 9. High energy intensive (energy counts for 10-20% of overall expenditures) | YES | NO | hienerg |
| 10. Medium en. intensive (energy counts for 5-10% of overall expenditures) | YES | NO | midenerg |
| 11. Low en. intensive (energy counts for 1-5% of overall expenditures) | YES | NO | lowenerg |

Is the production aimed at:

- | | | | |
|--------------------------------|-----|----|---------|
| 12. Other industrial producers | YES | NO | indprod |
| 13. End consumers | YES | NO | endcons |

PRESENCE OF AETs

14. Has your company promoted any energy conservation measures in the last 10 years? YES NO AET

Which of the energy saving technologies listed in annex a have been taken up by your firm in the recent past?

Telephone interviewer: please tick box, and ask respondent to specify when the technology was adopted--ask respondent to refer to list posted to him/her

① less than 2 years ago ② between 2 and 6 years ago ③ more than 6 years ago

House keeping energy saving measures

15. Lighting	1 2 3	houseke1
16. Plant heating systems	1 2 3	houseke2
17. Plant cooling systems	1 2 3	houseke3
18. Building envelope	1 2 3	houseke4
19. Plant ventilation systems	1 2 3	houseke5

Supply installations (adds-on) and process control

20. Pumps	1 2 3	addson1
21. Combined Heat and Power systems	1 2 3	addson2
22. Modification of production cycle to take into account the different energy rates	1 2 3	addson3
23. Electronic systems for optimum control (frequency control/speed regulation)	1 2 3	addson4
24. Other	1 2 3	addson5

Production installations and process cycle

25. Compressed air	1 2 3	Install1
26. Dryers, e.g. based on pulse drying technology (paper only)		Install3
27. Other systems for recovery and conversion of heat from primary production processes	1 2 3	Install4

ENERGY EFFICIENT PRODUCTION INSTALLATIONS AND PROCESS CYCLE MODIFICATION (interviewer: please note that different technologies apply to the two sectors)

28. Melting furnaces (foundries)	1 2 3	Core1
29. Heating retaining ovens (foundries)	1 2 3	Core2
30. <i>Low energy refiners, fractionation systems vacuum forming/moulding, use of enzymes to remove ink from fibers (paper)</i>	1 2 3	Core3
31. Presses, choppers, roll cutting, and slicing machines (paper)	1 2 3	Core4
32. Extruders and laminators, printing machines (paper)	1 2 3	Core5
33. Other core manufacturing processes (foundry and paper)	1 2 3	Core6

ENERGY MARKET AND PRODUCTION REGIME NATIONAL AND EUROPEAN REGULATORY REGIME

34. Are you aware of particular EC standards or regulations which affect the behaviour of your company YES NO ecregula

*If **yes** can you provide some example (if answer is NO proceed to 36.)*

35. *How important are the above?*

Telephone interviewer: please ask respondent to rank their importance on a scale of 1 to 5, where 1 is not important and 5 is very important.

1 2 3 4 5

impecreg

[Can you briefly describe how they affect the firm]

--

36. <i>Do you have access to different energy suppliers?</i>	YES	NO	freemkt
--	-----	----	---------

(If answer is NO proceed to 39)

37. <i>Are you able to negotiate on tariffs with your energy suppliers?</i>	YES	NO	priceneg
---	-----	----	----------

38. <i>Do you take advantage of these opportunities?</i>	YES	NO	Opport
--	-----	----	--------

39. <i>Has the price of energy risen over the past two years?</i>	YES	NO	priceris
---	-----	----	----------

40. <i>Has the price of energy fallen over the past two years?</i>	YES	NO	pricetal
--	-----	----	----------

41. <i>Have you considered the possibility of buying or did you buy energy from other firms?</i>	YES	NO	enerbuy
--	-----	----	---------

42. <i>Have you considered the possibility of selling energy or did you sell energy to other firms??</i>	YES	NO	enersell
--	-----	----	----------

Have you been affected by state policy initiatives on energy and how important have they been in affecting your company's behaviour and perceptions in relation to energy?

Telephone interviewer: please tick box, and ask respondent to rank the level of influence on a scale of 1 to 5, where 1 is not at all and 5 is very much.

43. Public subsidies	1 2 3 4 5	impsubsi
44. Awareness campaigns	1 2 3 4 5	impaware
45. Public provision of training and technical support	1 2 3 4 5	impECstd
46. Carbon tax	1 2 3 4 5	impcotax
47 Other energy taxes and levies	1 2 3 4 5	implevy
48. Facility of financing schemes	1 2 3 4 5	Imp-fina

49. How important are green issues and your environmental image for your customers and other business partners?

Telephone interviewer: please ask respondent to rank their importance on a scale of 1 to 5, where 1 is not important and 5 is very important.

1 2 3 4 5

imp-eco

MARKET AND COMPETITIVE PRESSURES

50. *How important is the behaviour of your competitors for the decision to invest in innovation technologies?*

Telephone interviewer: please ask respondent to rank their importance on a scale of 1 to 5, where 1 is not important and 5 is very important.

1 2 3 4 5

comp-Beh

INTERFIRM AND SUPPLY CHAIN RELATIONS

In relation to energy issues in your manufacturing processes, how significant is the input your company receives from any of the following?

Telephone interviewer: please ask respondent to rank their significance on a scale of 1 to 5, where 1 is not important and 5 is very important.

51. Government agencies	1 2 3 4 5	inpgov
52. Research institutes	1 2 3 4 5	inpresear
53. Professional bodies	1 2 3 4 5	inpprof
54. Own R&D	1 2 3 4 5	inr&d
55. Consultants	1 2 3 4 5	inconsult
56. Trading partners	1 2 3 4 5	inpartn
57. Suppliers of cap. goods	1 2 3 4 5	insupcap
58. Suppliers of energy	1 2 3 4 5	insupgoo
59. Suppliers of materials	1 2 3 4 5	insupmat

60. Other firms

1 2 3 4 5

inother

What type of input do you receive from each?

- a) Information on the availability of new technologies?
- b) Practical advice about implementation issues?
- c) Information about reliability issues?
- d) Information about the behaviour of competitors
- e) Information about cost effectiveness of technologies?

Telephone interviewer: please circle for each type of information the firm receives from each type of organisation. **NOTE** do not ask the question as it is, and try instead to derive information's through open question, and then coding.

61. Government agencies	a b c d e	infofov
62. Research institutes	a b c d e	infores
63. Professional bodies	a b c d e	infofro
64. Own R&D	a b c d e	infofor&d
65. Consultants	a b c d e	infocon
66. Trading partners	a b c d e	infoforpar
67. Suppliers of cap.goods	a b c d e	infosu1
68. Suppliers of energy	a b c d e	infosu2
69. Suppliers of materials	a b c d e	infosu3
70. Other firms	a b c d e	infofoth

BALANCE OF INTRA-FIRM INFLUENCE AND PRIORITY OF ENERGY IN MANAGEMENT AGENDA

71. Do you have a formal or explicit energy policy? YES NO policy

(if answer is no proceed to 65)

What form does it takes (document, handbook, etc.)

Which level of management is involved in its definition?

72. Director level	YES	NO	deftop
73. Senior management	YES	NO	defsenio
74. Middle management	YES	NO	defmiddle
75. Junior management	YES	NO	defjunio
76. Other	YES	NO	defother

Which management GROUP is involved in its definition?

77. Financial management	YES	NO	def-fin
--------------------------	-----	----	---------

78. Operations management/production engineering,	YES	NO	def-oper
79. Energy management	YES	NO	defeman

Who is responsible for implementing and managing the firm's energy policy

80. Financial management	YES	NO	polman-f
81. Operations management/production engineering,	YES	NO	polman-o
82. Energy management	YES	NO	polmanEM

Who is responsible for monitoring the firm's energy policy

83. Financial management	YES	NO	monit-fin
84. Operations management/production engineering,	YES	NO	monit-op
85. Energy management	YES	NO	monit-em

How important are the following in determining the degree of priority your firm gives to energy issues/energy policy?

Telephone interviewer: please tick box, and ask respondent to rank their importance on a scale of 1 to 5, where 1 is not important and 5 is very important.

86. Cost cutting	1	2	3	4	5	pricost
87. Important for our customers	1	2	3	4	5	pricusto
88. Important for the company's image with other business partners	1	2	3	4	5	priimage
89. Linked to other aspects of our manufact. strategy	1	2	3	4	5	pristrat

From your experience how would you rate the importance of energy issues to the top management of the firm. Do they treat energy as:

90. High priority	YES	NO	Hiimp
91. Secondary importance	YES	NO	secimp
92. An issue which is taken into account but of medium importance	YES	NO	medimp
93. An issue of minor importance	YES	NO	minimp
94. Totally ignored	YES	NO	ignored

SOCIO-TECHNICAL CHARACTERISTICS AND CONSTRAINTS

Which of the following factors hindered your decision to implement or not to implement advanced energy technologies (AETs)

Telephone interviewer ask respondent to rank the impact on a scale of 1 to 3, where:

1 strongly hindered 2 only a secondary issue 3 taken into consideration but without significant impact

95. The high degree of integration of your production process	1 2 3	socitec1
96. The modularity of the hardware involved	1 2 3	socitec2
97. The effects on other parts of the production process if one part was altered	1 2 3	socitec3
98. The risks and consequences of failure	1 2 3	socitec4
99. The existing value of technology in view of its residual productive life	1 2 3	socitec5
100. The technical constraints posed by existing production processes and the difficulties of changing to new ones	1 2 3	socitec6
101. The number of suppliers involved in procuring AETs	1 2 3	socitec7
102. The technical implications for the transaction with other firms created by the adoption of AETs	1 2 3	socitec8
103. The reliability of the innovation	1 2 3	socitec9
104. The relevant size of the investment involved	1 2 3	socitec10
105. An assumed payback period of 5 years	1 2 3	socitec11
106. The difficulty of availability of capital	1 2 3	socitec12

4.2 List of Companies

The following companies were contacted during the survey. The numbers used here do not correspond to the case numbers.

Foundries

- (1) Bernhard Amsbeck GmbH & Co. KG
Südstr. 5
48231 Warendorf
Deutschland
Tel. 02581/9340-0
- (2) Buderus Guss GmbH
Postfach 12 40
35573 Wetzlar
Deutschland
Tel. 06441/49-0
- (3) Georg Fischer Automobilguß GmbH
Julius-Bührer-Str. 12
78224 Singen
Deutschland
Tel. 07731/886-0
- (4) Richard Kablitz & Mitthof GmbH
Bahnhofstraße 72-78
97922 Laudakönigshofen
Deutschland
Tel. 09343/7901-0
- (5) Flender Guss GmbH
Obere Hauptstraße 228-230
09228 Wittgensdorf
Deutschland
Tel. 03722/642114
- (6) WESO-Aurorahütte GmbH
35075 Gladenbach
Deutschland
Tel. 06462/921-0
- (7) ALZMETALL Werkzeugmaschinenfabrik und Gießerei Friedrich GmbH
&Co.
Steiner Str. 2-8
83352 Altenmarkt
Deutschland
Tel. 08621/88-0

- (8) Eisenwerke Friedrich Wilhelm Düker GmbH & Co
Würzburger Str.
97753 Karlstadt
Deutschland
Tel. 09353/791-0
- (9) MRM Meyer Industrie
Nordhoffstr. 2
38518 Gifhorn
Deutschland
Tel. 05371/832552
- (10) Gebrüder Gienanth-Eisenberg GmbH
Ramsener Straße 1
67304 Eisenberg
Deutschland
Tel. 06351/408-0
- (11) Mercedes Benz AG Werk Mannheim

68299 Mannheim
Deutschland
Tel. 0621/393-0
- (12) Ford AG Schmiede- und Druckgußwerk MR/P-4
Henry-Ford-Straße 1
50725 Köln / Niehl
Deutschland
Tel. 0221/90-0
- (13) Allweiler AG Werk Radolfzell
Allweilerstr. 1-7
78315 Radolfzell
Deutschland
Tel. 07732/86-0
- (14) Thyssen Guss AG Schalker Verein
Postfach 10 01 23
45801 Gelsenkirchen
Deutschland
Tel. 0209/166-1
- (15) Silbitz Guss GmbH
Straße der Jugend 2
07613 Silbitz
Deutschland
Tel. 036693/805-0

- (16) BARTZ-Werke GmbH
Franz-Meguini-Straße
66763 Dillingen
Deutschland
Tel. 06831/7008-0
- (17) Gontermann-Piepers GmbH
Postfach 10 08 42
57008 Siegen
Deutschland
Tel. 0271/60305
- (18) Aluminium Norf GmbH
Koblenzer Straße 120
41468 Neuss
Deutschland
Tel. 02131/937-0
- (19) LEDA WERK GMBH & CO. KG BOEKHOFF & CO.
Groninger Straße 10
26789 Leer
Deutschland
Tel. 0491/6099-0

Paper Industry

- (1) Fr. Schettinger GmbH & Co. KG Verpackungen aus Voll- u. Wellpappe
Schiettingerstraße 3
95682 Brand/Opf.
Deutschland
Tel. 09236/660
- (2) FS-Karton GmbH
Düsseldorfer Str. 182
41460 Neuss
Deutschland
Tel. 02131/237-0
- (3) Zülpich Papier GmbH
Bessenicher Weg
53909 Zülpich
Deutschland
Tel. 02252/306-0

- (4) Strepp GmbH & Co. KG
Postfach 11 22
52362 Kreuznau
Deutschland
Tel. 02422/56-0
- (5) J.C. Binzer Papierfabrik GmbH & Co. KG
Berleburger Straße 71
35116 Hatzfeld
Deutschland
Tel. 06467/801-0
- (6) Papierfabrik Scheufelen Technische Betriebe
Adolf-Scheufelen-Str. 26
73252 Lenningen
Deutschland
Tel. 07026/66-0
- (7) Buchmann GmbH Kartonfabrik
Wasgaustraße 5
76855 Annweiler
Deutschland
Tel. 06346/27-0
- (8) Klingele Papierwerke GmbH & Co.
Zum Schöpfwerk 5
26826 Weener
Deutschland
Tel. 04951/303-0
- (9) Papierfabrik Cordier GmbH
Jägerthal 7
67098 Bad Dürkheim
Deutschland
Tel. 06322/939-0
- (10) Kartonfabrik Rieger GmbH & Co. KG
Riegerstraße 4
83308 Trostberg
Deutschland
Tel. 08621/804-0
- (11) Papierfabrik Adolf Jass GmbH & Co. KG Geschäftsleitung
Hermann-Muth-Straße 6
36039 Fulda
Deutschland
Tel. 0661/106-0

- (12) Dresden Papier AG
Postfach 249
07962 Greiz
Deutschland
Tel. 03661/616-0
- (13) Papierfabrik Albbruck GmbH & Co. KG
Alte Landstraße
79772 Albbruck
Deutschland
Tel. 07753/41-0
- (14) Arjo Wiggins Deutschland GmbH
Schwalbenstadt 1
72581 Dettingen
Deutschland
Tel. 07123/977-0
- (15) Moritz J. Weig GmbH
Polcher Straße 113
56727 Mayen
Deutschland
Tel. 02651/84-0
- (16) Papierwerke Halstrick
56316 Raubach
Deutschland
Tel. 02684/609-0
- (17) W. Euler Papierfabrik GmbH & Co. KG
Wilhelm-Euler-Straße
64625 Bensheim
Deutschland
Tel. 06251/1307-0
- (18) ZANDERS Feinpapiere AG Umweltschutz
Postfach 20 09 60
51439 Bergisch Gladbach
Deutschland
Tel. 02202/15-0
- (19) Delkeskamp Verpackungswerke GmbH
Hauptstraße 10 - 15
49638 Nortrup
Deutschland
Tel. 05436/51-0